

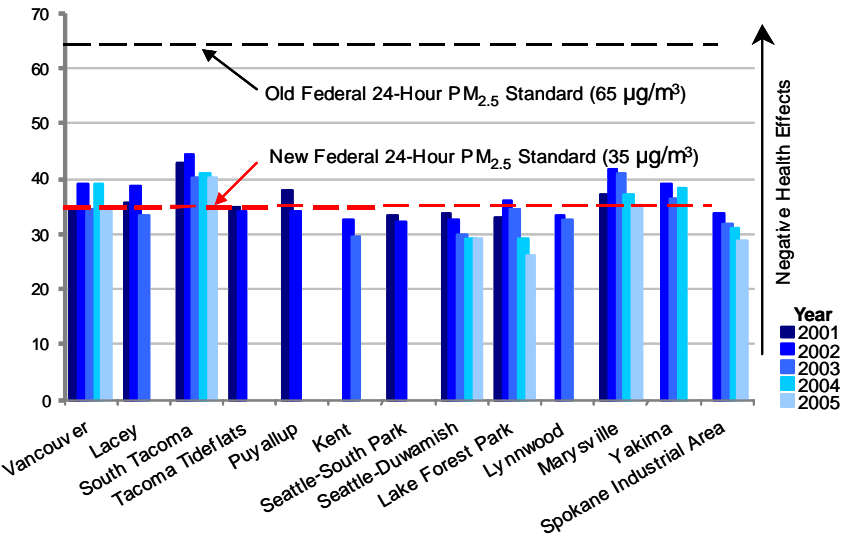
## How Does Washington Measure Up?

The EPA establishes national air quality standards to protect public health. When air pollution persistently exceeds these standards, the area is designated as “nonattainment”. Diesel exhaust contributes to levels of PM<sub>2.5</sub> and ground level ozone that exceed the national standards in many areas across the nation. The EPA has not set a standard specific to diesel exhaust.

Washington State is currently in attainment for both particulate matter and ozone. However, the EPA recently tightened one of its PM<sub>2.5</sub> standards. As a result, it is likely that some areas in Washington will be designated as non-attainment within the next few years. More may follow when additional monitoring data is available.

By working today, we can help to avoid violating these standards in the future and improve air quality.

**Washington State 24-Hour Average Concentration of PM<sub>2.5</sub>**  
98<sup>th</sup> Percentile Three Year Average (µg/m³) at Monitoring Sites



\* Washington State Department of Ecology, 2006

## Diesel Emission and the Environment

Diesel exhaust contributes to several air pollutants that can be harmful for the environment. Ozone and fine particles from diesel engines can form atmospheric haze, blocking views and scenery. Ozone also damages the environment and can make plants and crops more susceptible to disease or damage.

The NO<sub>x</sub> and sulfur in diesel emissions contribute to acid rain that damages streams, ponds, and lakes. In addition, greenhouses like CO<sub>2</sub> contribute to global warming.

**Clear View of Mount Rainier**



**Hazy View Around Mount Rainier**



\* Puget Sound Clean Air Agency



# Reducing Diesel Emissions in Washington State: Understanding Diesel Emissions

**Emissions from diesel engines can be harmful to public health and the environment. Here is information to help explain the problem.**

We find diesel engines are nearly everywhere. They power the movement of goods that support our economy, help construct buildings and roads, carry children to school, and move transit vehicles. While these engines are critical to our economy and lifestyles, their unfiltered exhaust contains harmful pollutants.

## Why are Diesel Emissions a Concern?

Diesel engines emit a complex mix of air pollutants, mainly made up of a gases and solid particles that many people can see as dark soot. These include many carbon particles as well as toxic gases and metals.

The microscopic soot in diesel emissions is one source of fine particulate matter (PM<sub>2.5</sub>), which is made up of very small particles and droplets in the air. These fine particles are so small that several thousand of them could fit on the period at the end of this sentence. They are a health concern because they can be breathed deeply into the lungs and sometimes pass directly into the bloodstream - potentially affecting the lungs, heart, and other organs.

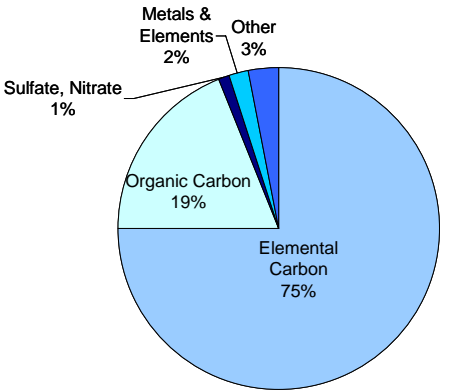
The US Environmental Protection Agency (EPA) has identified the mix of diesel particulate matter (DPM) as a toxic air contaminant causing harmful health effects, potentially including cancer. DPM has been identified as one of six priority toxic pollutants of national concern linked to transportation (known as mobile source air toxics or MSATs).

Diesel exhaust also contains nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOCs or hydrocarbons). These pollutants contribute to ground-level ozone or smog. Breathing ozone can worsen asthma and other lung diseases. The combustion of diesel fuel also produces greenhouse gases, such as carbon dioxide (CO<sub>2</sub>). However, health and environmental communities are primarily concerned about the toxic effects of diesel particulate matter.

## Researchers Learn More About Diesel Each Year

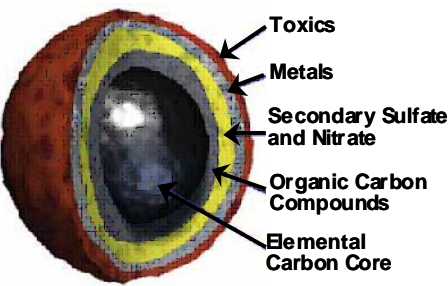
Emissions from diesel engines, especially particulate matter, appear to contribute to a number of health problems. Long-term exposure is associated with an increased risk of heart and lung diseases, including lung cancer and heart attacks, and may lead to premature death. Short-term exposure can irritate the eyes, nose, and throat, and cause difficulty breathing, fatigue, and headaches. Children, outdoor workers, people with heart and lung disease, and the elderly are most at risk.

**Typical Chemical Composition of Fine Particulate Matter (PM<sub>2.5</sub>) from Diesel Vehicle Exhaust**



\* Health Effects Institute (2003)

**Diesel Particle After Released from an Engine**



*Diesel particles are carbon at their core with toxics and carcinogenic substances attached to their surfaces.*

\* Clean Air Task Force (2005)

**Estimated Annual Health Impacts in Washington State From Diesel Soot (1999)**

Premature Deaths	248
Lung Cancer Deaths	23
Non-fatal Heart Attacks	308
Asthma Attacks	6,201
Chronic Bronchitis	181
Lost Work Days	37,787
Minor Restricted Activity Days	218,999

\* Clean Air Task Force (2005)

## For More Information

Elizabeth Stratton  
Freight Policy & Project Manager  
(206) 716-1178, [stratte@wsdot.wa.gov](mailto:stratte@wsdot.wa.gov)

Mia Waters  
Air Quality Program Manager  
(206) 440-4541, [watersy@wsdot.wa.gov](mailto:watersy@wsdot.wa.gov)

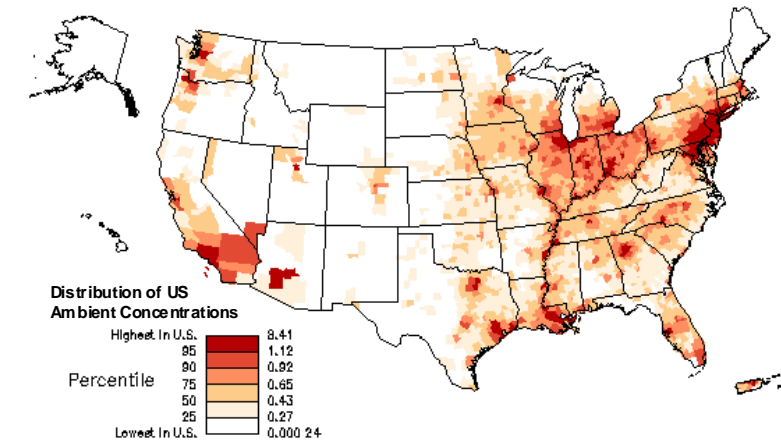
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## Diesel Emissions are Often Concentrated in Urban Areas

Diesel emissions affect both urban and rural communities, but they create the most problems for populations living and working very close to diesel sources. The following charts show how diesel emissions are often concentrated in urban areas, where high population density also means more people are exposed. Each person can be exposed to a unique level of emissions based on how close they live and work to significant sources.

**Concentration of Diesel Particulate Matter**  
1999 Estimated County Median Ambient Concentrations ( $\mu\text{g}/\text{m}^3$ )



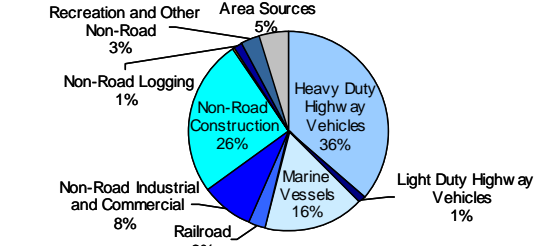
\* US EPA 1999 NATA National- Scale Air Toxics Assessment (2006)

## Where do Diesel Emissions in Washington State Come From?

Recent studies by the Washington State Department of Ecology show that most diesel emissions in the state come from roadway vehicles (such as trucks and buses), marine vessels, construction and agricultural equipment.

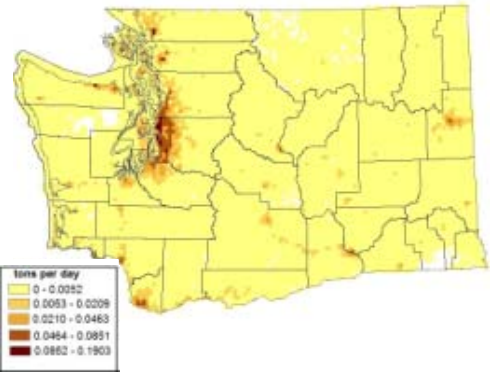
With Washington's diverse regions, sources of diesel emissions can vary greatly across the state. In Spokane County, marine vessels are not a source of diesel emissions, but in Central Puget Sound marine vessels contributed 16 percent of diesel particulate matter in 2002. WSDOT is participating in a study with the Puget Sound Maritime Air Forum to refine information about marine emissions in Central Puget Sound.

**Sources of Diesel Particulate Matter in Central Puget Sound, 2002**  
3,220 total tons per year



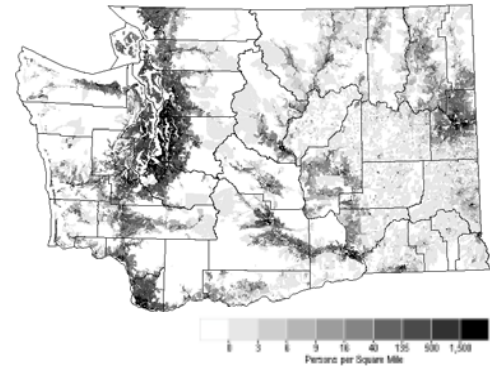
\* Washington State Department of Ecology, 2006

**Diesel Particulate Matter Density in Washington State, 2002**



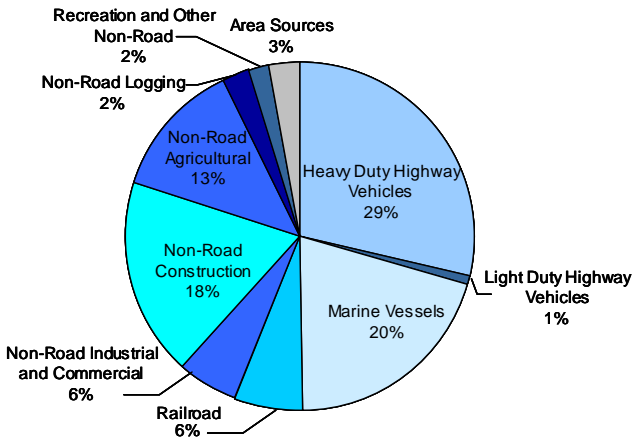
\* Washington State Department of Ecology, 2006

**Population Density in Washington State, 2000**



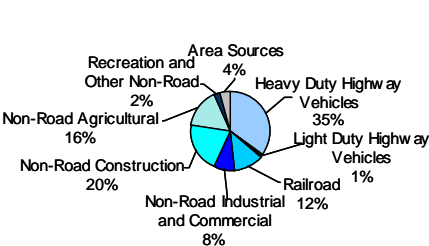
\* State of Washington Office of Financial Management, 2006

**Sources of Diesel Particulate Matter in Washington State, 2002**  
7,701 total tons per year



\* Washington State Department of Ecology, 2006

**Sources of Diesel Particulate Matter in Spokane County, 2002**  
377 total tons per year



\* Washington State Department of Ecology, 2006

## Diesel Exhaust and Cancer

The Department of Health and Human Services, EPA, National Air Toxicology Association, National Institute of Environmental Health Sciences, and World Health Organization have all listed diesel exhaust as a likely or probable carcinogen. Long-term exposure may pose a risk for lung cancer, and potentially other types of soft tissue cancer.

About 90 percent of lung cancer is caused by active smoking. Responsibility for the remaining 10 percent is split among second-hand smoke, previous exposure to asbestos, exposure to radon gas, and other causes, including diesel exhaust. Of the cancer risk from air borne pollutants, the Washington State Department of Ecology estimates that diesel particulates cause about 70 percent.

There is still debate about the exact risk of cancer from long-term exposure to diesel exhaust. Different agencies have developed different methodologies and risk factors used to calculate the risk of cancer based on exposure.

The US EPA, in 2002, found diesel exhaust to be a likely human carcinogen, but did not adopt a risk factor. EPA did estimate a possible range of lung cancer risk from exposure to diesel exhaust in the environment ranging from 0.1 to 10 excess cancer risks in 10,000 people per 1  $\mu\text{g}/\text{m}^3$  diesel PM lifetime exposure of 70 years. This means that if one million people were exposed to one microgram of diesel PM in a cubic meter of air, there is a chance that 10 to 1,000 of them have a risk of getting cancer over a 70-year lifetime with the same exposure. This range is based on exhaust emissions from diesel engines built before the mid 1990s.

The California Air Resource Board, in 1998, assigned a unit risk value of 3 excess cancer cases in 10,000 people per 1  $\mu\text{g}/\text{m}^3$  diesel PM lifetime exposure.

\* Health Effects Institute (2003), American Cancer Society (2006), US Environmental Protection Agency (2002), California Air Resource Board (1998), Clean Air Task Force (2005)

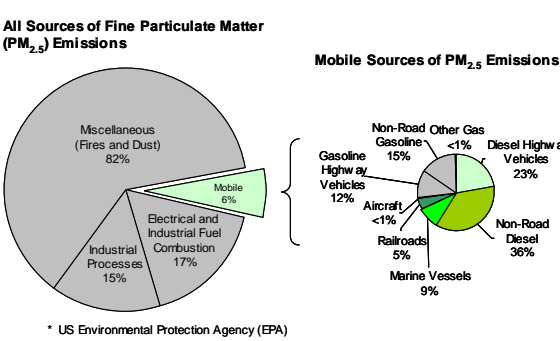
## How Much Does Diesel Exhaust Contribute to Air Pollutants?

In addition to the specific toxicity concerns of diesel particulate matter, diesel exhaust contributes to levels of pollutants in the air. Diesel is just one of many sources for these air pollutants. The following information provides a snapshot of sources for some of these pollutants, and how much diesel engines contribute to levels of these pollutants in the air. Sources vary from region to region, and pose the greatest concern for public health when they occur close to populations.

### National Perspective - Diesel Emissions Contribute to Five Percent of all $\text{PM}_{2.5}$

Data used today for the nation as a whole, indicates that diesel emissions contribute to five percent of all fine particulate matter ( $\text{PM}_{2.5}$ ). Fires and dust are the largest sources (60 percent).

**National Sources of Fine Particulate Matter in 2002**



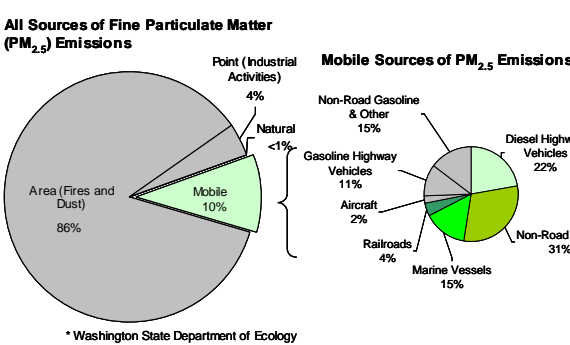
\* US Environmental Protection Agency (EPA)

Diesel emissions also contribute to 33 percent of all nitrogen oxides (NOx), three percent of all volatile organic compounds (VOC), three percent of all sulfur oxides (SOx), and two percent of all carbon monoxide (CO) at the national level.

### Washington State Perspective - Diesel Emissions Contribute to Seven Percent of all $\text{PM}_{2.5}$

In Washington State, data indicates that diesel emissions contribute to seven percent of all fine particulates. Indoor and outdoor burning is the largest source (about 50 percent).

**Washington State Sources of Fine Particulate Matter in 2002**

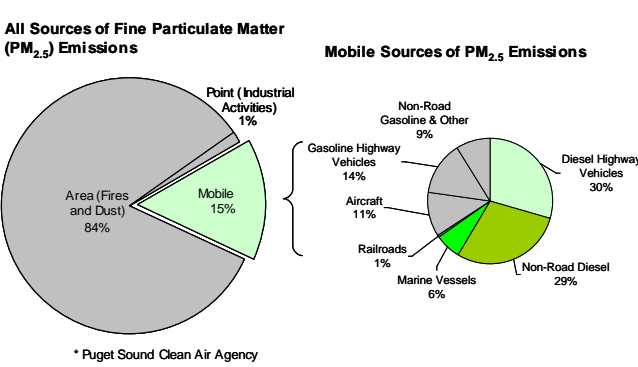


\* Washington State Department of Ecology

### Central Puget Sound Perspective - Diesel Emissions Contribute to Ten Percent of all $\text{PM}_{2.5}$

In Central Puget Sound, diesel emissions contribute to ten percent of all fine particulates. Indoor and outdoor burning is the largest source (about 50 percent).

**Central Puget Sound Sources of Fine Particulate Matter in 2002**



\* Puget Sound Clean Air Agency

Diesel emissions also contribute to 46 percent of all nitrogen oxides, three percent of all volatile organic compounds, 42 percent of all sulfur oxides, and two percent of all carbon monoxide at the regional level.

In the Central Puget Sound urban areas, where more people are generally exposed to these pollutants in close proximity, diesel emissions contribute to 15 percent of all fine particulates.